Synchronous machine Alternator

Alternator

- Synchronous motors run in synchronism with the revolving field. The speed of rotation is therefore tied to the frequency of the source. Because the frequency is fixed, the motor speed stays constant

Motor

Synchronous motor

Construction

Also see class notes, 24-02-4.jpg

- The part of the machine in which voltage is induced is called **armature**.
- Relationship btw *rotor speed* N_s, *Frequency* of generated E.M.F. f and poles P is given by

$$N_s = \frac{120f}{P}$$

Merits of rotating field & static Armature.

1. Armature winding is much more complex, Therefore it is **easy to place** armature winding **on static structure**.
2. Due to heavy conductors there will be huge centrifugal force due to which high stresses is developed.
3. Reduced friction and windage loss.
4. Due huge voltage need to collected by slip rings it requires high insulation else it will cause flash over.
5. Better insulation and cooling can be provided in static structure than in rotating one.

Winding factors

Distribution factor and Pitch factor Pitch factor

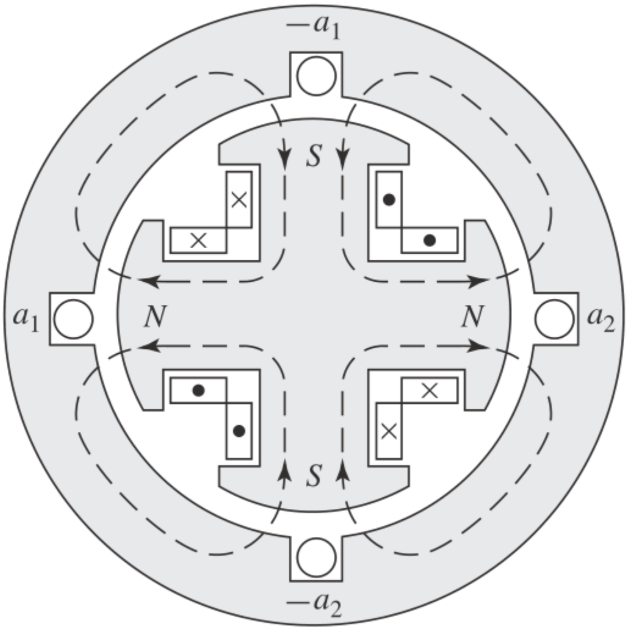


Figure 4.6 Schematic view of a simple, four-pole, single-phase synchronous generator.

> Courtesy of A.E. Fitzerald

When an alternator has more than 2 poles it is convenient to concentrate on a single pair of poles and to recognize electric magnetic and mechanical condition associated. For this reason it is convenient to use electrical degree than physicals quantity.

Q & A

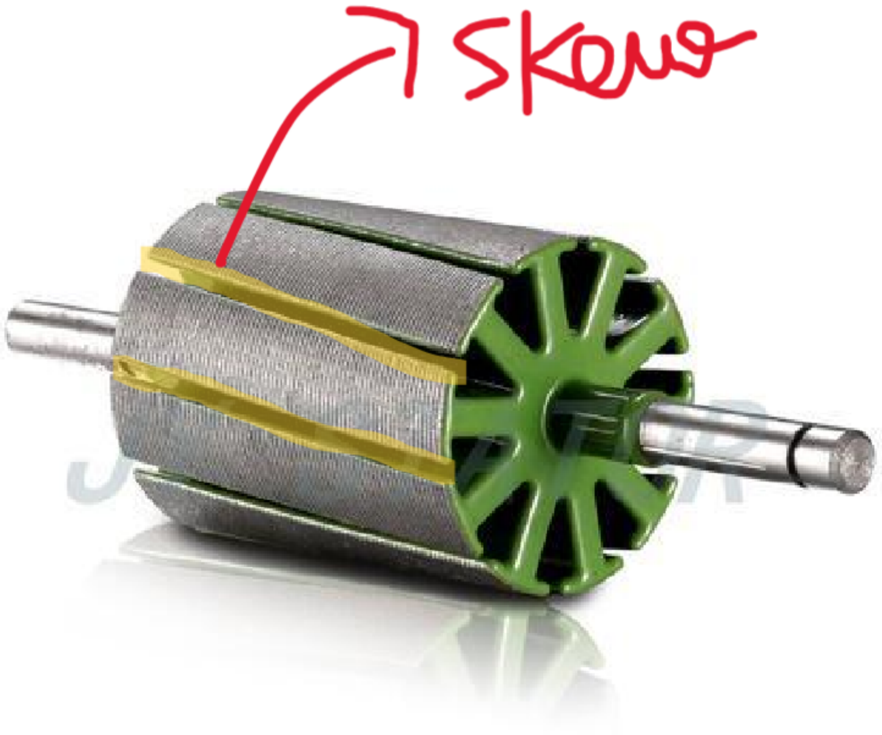
Two marks

1. How harmonics form in an alternator?

- Harmonics in output waveform are developed due to **non-sinusoidal** field flux.
- **Variation of reluctance in airgap** due to slotting of stator core will also produce harmonics.

2. How can we suppress harmonics?

- Short pitching the winding.
- By well distributed windings.
- Use slightly larger airgap to increase reluctance.
- Use skewed poles by one-slot pitch.



3. Mechanical angle and electrical angle.

- A pair of poles represent 360^0 electrical.
- Physical angular displacement represent in a machine is mechanical angle.

$$\frac{Poles}{2} \times \theta_{mech} = \theta_{electrical}$$

4. Why do we prefer short pitched windings?

- Conductor cost is reduced.
- Harmonics is reduced or killed.
- Since it reduces slot reactance this wave shape of generated EMF is improved.